The Use of Telehealth in Early Intervention for Children with Neurodevelopmental Disabilities: A Scoping Review

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Summary. *This scoping review was aimed to identify the extent and range of the existing literature on the use of telehealth early intervention for children with neurodevelopmental disabilities.*

Methods. The data sources include Medline (PubMed), Cumulative Index of Nursing and Allied Health Literature (CINAHL) and PsycINFO along with reference lists of relevant reviews and involved articles. Study eligibility criteria were studies that assess the use of telehealth for implementation of assessments and/or early interventions for children aged 0–6 years with diagnosis of all types of neurodevelopmental disabilities. Narrative synthesis and tables of results of telehealth studies were developed.

Results. The services delivered included diagnostic assessment for autism spectrum disorder, speech and language screening, educational training, guidance, and supervision in the implementing interventions for children with autism spectrum disorder, behaviour problems, speech and language delays, hearing problems, preterm, developmental problems, and cerebral palsy.

Conclusions. Telehealth has a potential for autism spectrum disorder, speech, and language impairments identification. Also, telehealth is a promising model to deliver behaviour, communication, and speech and hearing targeted interventions. There is a lack of studies on using telehealth in early interventions for children with other types of neurodevelopmental disabilities (e.g., cerebral palsy).

Introduction

Telehealth (also known as 'telepractice' and 'telemedicine') involves the application of communication technologies to enable specialists to consult and deliver services over far distances using digital information and communication technologies, such as computers, mobile devices, video conferencing, and remote patient monitoring. Early intervention (EI) means identifying and providing effective early support to children who are in danger of poor outcomes. EI focuses on helping infants and toddlers who have a developmental delay or disability learn the fundamental and brand-new skills that typically develop during the primary three years of life, such as physical, cognitive, communication, social, emotional and self-help dress.

Many children have a neurodevelopmental disorder, like cerebral palsy (CP), intellectual disability or autism spectrum disorder (ASD). In high income countries, the prevalence of CP is 1–3%, that of intellectual disability is about 1% and that reported for ASD is 0.5–3% (1). Delivering video interventions through telemedicine approaches using videoconferencing could be a valuable option which will reduce care access inequalities, promote early family-centred care culture, and contribute to a simpler and efficient healthcare approach to the rehabilitation programme of kids with neurodevelopmental disorders (NDD).

Over the past century research has proven that EI may improve long-term outcomes for children with NDD. Implementation of evidence-based practice often needs a multidisciplinary team (e.g., speech-language pathologist, physiotherapist, occupational therapist, special educator, and psychologist). Due to the smaller number of highly trained professionals, children with NDD are often evaluated and treated by less qualified personnel, particularly in pandemic time (2). Internationally the COVID-19 pandemic has meant that children are isolated with lockdowns preventing school attendance, and where attendance is possible, social distancing has reduced the capacity of services to meet the needs of children requiring medical intervention and support (2). The use of telemedicine therefore becomes essential. For example, in the use of tele-rehabilitation, patients have reported a high level of satisfaction, reinforcing the hypothesis that the rehabilitative services at a distance could be a feasible alternative to routine care (2). So far, it has been employed in different conditions, but it may provide a valuable approach in patients with neurological disorders, including children with cerebral palsy. During situations like

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outbreaks, telerehabilitation has the extra advantage of continuous rehabilitation supervision remotely without the danger of virus exposure. For people who can perform rehabilitation reception with guidance from telerehabilitation, this could be their first option (3). Tele practice can be used to connect doctors in hospitals to home patients who need consultations. It is possible that tele practice may also be helpful in connecting specialists of EI to parents of children who have or are at risk of neurodevelopmental disorders to provide screening tests, interventions, and support.

Although the use of telehealth in the assessment and treatment of children with neurodevelopmental disabilities has been evaluated in several studies, only a few reviews of this research have been published. Based on an iterative search using PubMed, there are several studies that involve use of telemedicine for children, but there is a lack of reviews where they provide support for children with NDD. Most of reviews focus on separate disorders for example hearing problems, speech pathology or ADS.

This scoping review was aimed to identify the extent and range of the existing literature on the use of telehealth early intervention for children with neurodevelopmental disabilities.

Materials and Methods

Search Strategy. In our scoping review, we used the Preferred Reporting Items for Scoping Reviews (PRISMA-ScR) Checklist (4). This review process was performed using a non-published protocol. Medline (PubMed), Cumulative Index of Nursing and Allied Health Literature (CINAHL), and PsycINFO were systematically searched for data published from 2011 to 2021. Search terms were: "tele practice," "teleconference," "skype" ©, "iChat" ©, "videoconferencing," "distance education," "telehealth," "teletherapy," "telerehabilitation", "telemedicine" AND "developmental delay", "developmental disabilities", "developmental education", "developmental coordination disorder", "early intervention", "cerebral palsy", "mental retardation", "autism", "rare diseases", "speech disorders", "language delay", "language diseases" in diverse combinations. The reference lists of relevant papers were checked for eligible articles missed from the original electronic searches. English language studies were extracted.

Study Selection. We only observed those studies that used telemedicine methods (video-conferencing, telephone calls, communication using computer programs, etc.) in early diagnosis and early intervention field for children aged 0–6 years with all types of NDD diagnosis. All included studies had a control group of home visits or usual care in clinic. It was therefore decided to conduct a review that involves studies from 2011 until 2021 which included all relevant NDD articles.

Exclusion criteria included studies older than ten years, were only abstracts, reviews, articles in other languages, editorials and commentaries, adult studies, other diseases, not early intervention studies.

Data Extraction. In this review, the Medline program was used for collecting articles. For all selected studies, the full texts were retrieved and examined. From the studies this information was extracted: author(s), year of publication, study location, participants, aim of study, study design, type of technology and service delivery via telehealth, outcome measures and results.

Results of the data analysis were organized along two themes: 1) telehealth interventions aimed to identify neurodevelopmental disabilities, and 2) telehealth interventions designed to provide intervention or educational programs.

Results

Characteristics of the Included Studies. The search in three databases identified 7583 titles in PubMed (n = 4402), CINAHL (n = 2404), and PsychINFO (n = 777), narrowed down to 506. Thirty-eight studies that met the requirements were analysed, while the remaining 468 were excluded because were not NDD, not EI, children older than 6 years old, or were validity and reliability studies (Fig. 1). There were randomized-controlled (n = 11), pilot randomized-control trial (n = 2), non-randomized-clinical trial (n = 6), pilot (n = 5) and case studies (n = 9). The number of the participants in all studies varied from 3 to 464, and the mean age range was from 0 to 6 years old. Most of the studies used widely available technology to implement tele practice, such as laptop computers with both internal or peripherally connected microphones and web cameras connected to the Internet via high-speed Internet connections. A video was transmitted at a rate of either 15 or 30 frames per second (fps). Skype and software programs were used as well as telephone calls and messages. Skype allows video and voice calling over a variety of different mobile internet devices and is currently available for free download.

Telehealth Interventions Aimed to Identify Neurodevelopmental Disabilities. Five studies explored interventions aimed to provide screening and/or, assessment of speech, language, hearing impairments, or autism (Table 1). Reese and colleagues (5) examined the utility and validity of an autism spectrum disorder (ASD) assessment protocol conducted via video conferencing. The protocol included a 20-minute observation of the child in an unstructured play setting with age-appropriate toys, coaching the parents to implement Autism

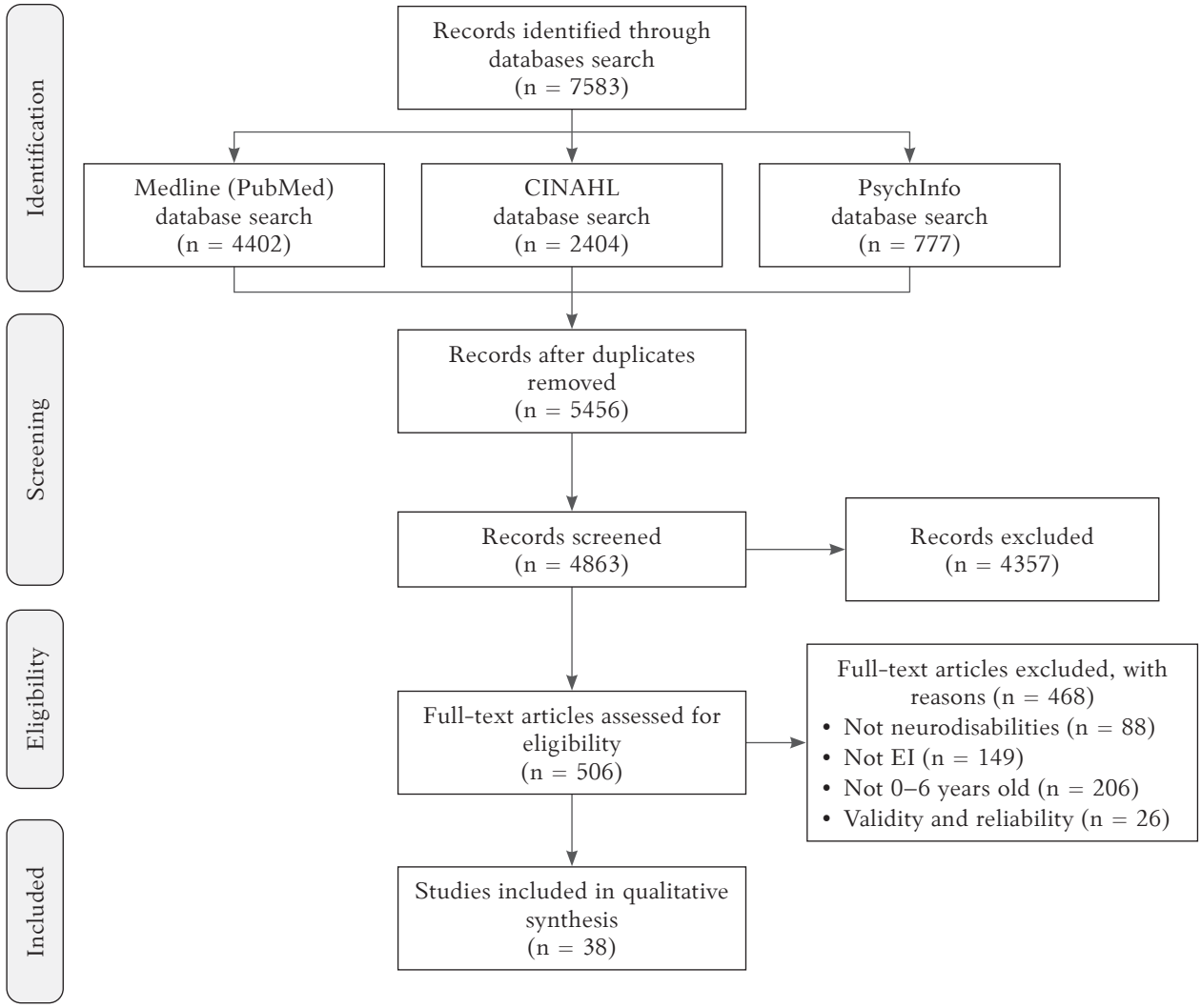

Fig. 1. Flowchart on the selection of studies
Note: EI, early intervention; last collection date: 01/21/2021

Diagnostic Observation Schedule Autism (ADOS-2) activities, structured interview using only the Autism Diagnostic Interview (ADI-R) algorithm items, and medical and family history. Results demonstrated excellent inter-rater agreement on diagnoses between clinicians in the VC setting and the interdisciplinary team. Similar results were reported by Juarez and colleagues (6) who evaluated the potential value of ASD telemedicine-based diagnostic consultation service. First, they evaluated telemedicine diagnostic accuracy and validity in 20 children with ASD signs. For this 7-month stage, they used DSM-5, STAT, MSEL, VABS-2, and ADOS-2 evaluation methods. Twenty percent of children were diagnosed with ASD in person, but not via the telemedicine procedure. The second step of this research was to evaluate tele diagnostic feasibility, family perception, and clinical value. In this 11-month stage, there were 45 children with their families who provided feedback after the completion of telemedicine procedure. The study results revealed a high satisfaction level of families, but for diagnosis via the telemedicine procedure, it was not sufficient. This study findings suggest only preliminary feasibility, accuracy, and clinical utility for assessment of ASD via the telemedicine-based procedure. Wacker and colleagues (7) suggested that behaviour analysis of children with a risk of ASD via videoconferencing can be effectively and efficiently observed and diagnosed. In their study, there were 20 children and families who lived 50 miles from the centre. This study showed comparable results to direct service delivery in children's home. Telemedicine-based service may therefore provide a cost-effective strategy for delivering behavioural services.

A study by Mark Guiberson (8) aimed to describe the classification accuracy of individual telehealth language screening measures used with Spanish-speaking toddler-age children. Video conferencing related speech and language assessment

Table 1. Studies that investigated the use of telehealth for the screening of neurodevelopmental disabilities

DIAGNOSTIC ASSESSMENT STUDIES (n = 5)						
Diagnosis	Article	Participants characteristic	Technology type	Environment	Outcome measures	Results
Autism spectrum disorder (n = 3)	Wacker et al., 2013	n = 20, 29–80 m	VC	Clinic	Survey, FA, Child behaviour analysis	Results suggested that behaviour analysts can conduct functional analyses effectively and efficiently via telehealth.
	Juarez et al., 2018	n = 45, 20–34 m	VC	Clinic	DSM-5, STAT, ADOS-2, Likert	Families indicated high levels of satisfaction. Clinicians diagnosed 62% of children with ASD but did not feel capable of finding out ASD in 13% of cases.
	Reese et al., 2015	n = 17, 2.5–6 y	VC	Clinic/Home	ADOS, ADI	VC may be an effective method to increase access ASD diagnostic services.
Speech and language impairments (n = 2)	Guiberson et al., 2016	n = 82, 37–69 m	VC	Clinic/Home	SPLS-4	Processing efficiency measure, combined with a complex telehealth model and a parent survey or language sample measure can provide diagnostic information.
	Ciccia et al., 2011	n = 411, up to 6 y	Skype (VC)	Home	Survey, verbal survey	Low-cost videoconferencing for screening of speech, language, and hearing development in very young children in urban community health clinics is feasible, reliable and strongly supported by the community

ASD, autism spectrum disorder; VC, video conferencing; FA, functional analysis; ADOS-2, autism diagnostic observation schedule; ADI-R, autism diagnostic interview; STAT, screening tool for autism in toddlers & young children; SPLS-4, preschool language scale-fourth edition; y, years; m, months.

measures were associated with standardized language scores, only reported vocabulary had classification accuracy values that were desirable for screening for DLDs. Greater screening efficacy was achieved when reported vocabulary was combined with several different words that children produced during interactions with parents. One large study (411 participants) addressed speech, language, and hearing screening. This low-cost study showed that videoconferencing in very young children is feasible, reliable, and strongly supported by the community (9).

Studies that Describe Interventions Delivered via Telehealth. Twenty-seven studies explored interventions aimed to provide treatment for ASD (12 studies), behaviour problems (5 studies), speech and language delays (4 studies), hearing problems (4 studies), preterm (1 studies), developmental problems (1 study), and cerebral palsy (1 study) (Table 2).

Twelve studies explored the feasibility and validity of the telehealth approach to deliver coaching interventions for parents who have children with ASD. All studies had a small sample (3–27,) except for one with 107 subjects) and investigated telehealth using VC or self-guided websites. The large and methodologically strong study of Lindgren and colleagues (10) explored the use of Applied Behaviour Analysis (ABA) methods via telehealth by using three service delivery models: in-home therapy, clinic-based telehealth, and home-based telehealth. Interestingly, all three service delivery models demonstrated the same and successful reduction of problem behaviour and increasing functional communication. Total costs for implementing treatment were lower for home telehealth, but both telehealth models were significantly less costly than in-home therapy. Other studies used more complex behaviour, learning and communication targeted intervention programs and also found that interventions delivered via telehealth improved parent intervention skills and engagement as well as child communication, learning skills and behaviour (11–18). However, in two case

Table 2. Studies that describe interventions delivered via telehealth

INTERVENTION STUDES (n = 33)								
Diagnosis	Article	Type of the study	Participants characteristic	Technology type	Intervention	Environment	Outcome measures	Results
Autism spectrum disorder (n = 12)	Simac et al., 2017	Case	n = 3, 3–5 y	VC	Parent functional communication training	Clinic/Home	Interview, observation	Parent coaching via VC showed effective strategies for children's early communication skills.
	Vismara et al., 2013	Pilot	n = 9, 0–36 m	VC	Parent coaching, 12-week online	Home	Survey, P-ESDM, video analysis	Telehealth may support parental learning and improve child behaviour for some families.
	Ingersoll et al., 2015	nRCT	n = 27, 27–73 m	VC	Self-directed parent coaching	Clinic/Home	Parent satisfaction survey	Families with ASD children during VC intervention felt confidently of support.
	McDuffi et al., 2013	Pilot	n = 8, 2–6 y	VC	Language intervention of play-based parent-child interaction.	Clinic/Home	Observations and analysis	Parents became more confident in communicating with their child and helping to focus more.
	Lindgren et al., 2016	nRCT	n = 107, 21–84 m	VC	Parent coaching ABA method	Clinic/Home	Survey, FA	The mean percentage reduction in problem behaviour was > 90% in all groups.
	Subramaniam et al., 2016	Case	n = 4, 18 m – 12 y	VC	Parent training, twice a week	Home	Survey, ADOS	Parents felt comfortable and more confident after training.
	Suess et al., 2014	Case	n = 3, 18 m – 6 y	VC	Parent functional communication training	Clinic/Home	Survey, video analysis	All children showed substantial reductions in problem behaviour.
	Little et al., 2018	nRCT	n = 18, 2–6 y	VC	Occupation-based parent coaching	Clinic/Home	GAS, COPM-2, APCP, SRS-2	Occupation-based coaching delivered via telehealth increased parent efficacy and child participation.
	Vismara et al., 2018	RCT	n = 27, 30–79 m	VC	Weekly training sessions for parent	Home	ADOS	ASD children's social communication improved in all groups, but in a VC group, parent's confidence was higher.
	Gerow et al., 2021	Case	n = 7, 3–11 y	VC	Parent training for child's challenging behaviour	Home	Observation and functional analysis	Parent-implemented FA with coaching via telehealth leads to the development of successful function-based interventions.

Continuation of Table 2

INTERVENTION STUDES (n = 33)								
Diagnosis	Article	Type of the study	Participants characteristic	Technology type	Intervention	Environment	Outcome measures	Results
Autism spectrum disorder (n = 12)	Kobak et al., 2011	Pilot	n = 23, 18 m – 6 y	TC	Parent coaching by tutorials for communication and behaviour	Clinic/Home	Pre- and post-test scores of parents' knowledge	The mean number of correct items on the post-test significantly increased.
	Pierson et al., 2021	Case	n = 4, 5–8 y	TC	Parent coaching of dialogic reading via telepractice	Home	Visual and statistical analysis	A functional relation was observed between parent implementation and telepractice coaching.
Behaviour problems (n = 5)	Sourander et al., 2016	RCT	n = 464, 4 y	TC	11 weekly session parent training	Clinic/Home	24-CBC, PC, ICUS, 21-DAS	There was higher parent satisfaction and confidence about their capacities in a VC group.
	Comer et al., 2017	PRT	n = 22, 4–8 y	VC	Paret training via VC platform	Home	VTC platform, FB-CBT, survey, video analysis	72.7% of internet cases and 60% of clinic cases showed excellent response of intervention.
	Reid et al., 2013	RCT	n = 178, 2–5 y	TC	Parent coaching combined a self-help booklet and calls	Home	ECBI, PS, parents satisfaction questionnaire	Behaviour problems decreased significantly more in the intervention group.
	Studartt et al., 2015	Pilot	n = 16, 1–4 y	TC	Parent coaching via HM and TC	Home	Survey, video analysis	TC appears an acceptable and convenient mode of delivering sleep support, valued by both parents and practitioners.
	Singer et al., 2018	Case	n = 38, 5–7 y	TC	Parent coaching and telephone calls with the psychologist	Home	Phone calls, survey	The LTF (n = 14) had significantly higher scores, than the ITT (n = 24) group, on all ADHD ratings ($P < 0.01$), but not stereotypy severity.
Hearing loss, hearing impairment (n = 4)	Constantinesc et al., 2014	nRT	n = 14, 2–5 y	VC	Parent coaching of communication	Home	PLS-4	Parents were satisfied and confident with VC intervention.
	Havenga et al., 2017	Pilot	n = 10, 16–61 m	VC	Parent training weekly	Clinic/Home	Survey, video analysis	No significant difference was found between tele-intervention and conventional intervention.

Continuation of Table 2

INTERVENTION STUDES (n = 33)								
Diagnosis	Article	Type of the study	Participants characteristic	Technology type	Intervention	Environment	Outcome measures	Results
Hearing loss, hearing impairment (n = 4)	Behl et al., 2017	nCT	n = 48, 36 m	VC	Parent coaching for communication	Clinic/Home	Parents self-report form, PLS-5, HCRS-adapted	Children in a VC group scored statistically significantly higher results in PLS-5 than a UC group.
	Blaiser et al., 2013	RCT	n = 27, 18–19 m	VC	Individualized family plan, parent training and consultations	Home	Parent Engagement, Home Visit Rating Scales	The telehealth group scored statistically significantly higher on the expressive language measure than an in-person group (p = 0.03).
Speech and language delay (n = 4)	Bridgman et al., 2016	RCT	n = 49, 3–5 y	Webcam	Parent communicates with speech-language specialist once a week	Home	Survey, video-analyses	Results suggest that this programme is an economically effective method.
	McDuffie et al., 2016	Case	n = 6, 3–6 y	VC	Parent weekly education of language development training	Clinic/Home	Survey, spontaneous communication analysis	Parents increased their communication with their child, helped with their focus of attention and promoted communication acts.
	Olson et al., 2016	Pilot	n = 27, 11–36 m	TM	Parent coaching, of language development	Home	Survey, analysis	Text messaging was a more feasible and inexpensive platform for delivering developmental education to families.
	Ekberg et al., 2018	Case	n = 4, 3–5 y,	VC	Play-based therapy, parent training	Home	Video analysis, survey	Both VC and in-person sessions were similarly effective.
Preterm (n = 2)	Sgandurra et al., 2017	RCT	n = 41, 3–5 m	CARETOY	Parent training in daily activities	Home	IMP, AIMS, TAC	CareToy system can provide effective home-based EI during daily family activities.
	Ziegler et al., 2021	RCT	n = 16, 25–30 m	COPCA	Training caregivers to stimulate the infant's daily development	Home	Infant and family outcomes and video analyses of therapy sessions	COPCA participants improved significantly more between baseline and 18 months in the IMP variation and performance domains than standard care participants.

Continuation of Table 2

INTERVENTION STUDES (n = 33)								
Diagnosis	Article	Type of the study	Participants characteristic	Technology type	Intervention	Environment	Outcome measures	Results
Complex developmental problems (n = 4)	Jimenez et al., 2018	PRCT	n = 64, 13–24 m	TM	Weekly parent coaching	Home	Survey, video analysis	Parents were more satisfied with the text messaging programme.
	Kronberg et al., 2021	Case	n = 17, 6–34 m	VC	Caregivers coaching, identifying of caregiver's goals	Home	COPM, GAS	Results showed significant improvements in parent satisfaction, child performance, and goal attainment (all $p < 0.01$).
	Ziegler et al., 2020	A qualitative study	n = 15, up to 36 months	COPCA	Families with an infant with special needs received COPCA course	Home	Study-specific questionnaire	Mothers especially valued its home-based setting, the support from the coach, and the experience being able to participate as active partners in the intervention making their own decisions.
	van Balen et al., 2019	RCT	n = 46, 3–6 m	COPCA	Infants received the family-centred programme or another infant physical therapy	Home	Standardized observation protocol	Development of direction specificity and anticipatory activation in COPCA infants better mimicked typical development. Infants who received COPCA had an increase in direction specificity with increasing age.
Palsy (n = 2)	Surana et al., 2019	RCT	n = 24, 2–13 y	VC	Caregivers training, progress and skill progression were monitored, and supervision was provided via weekly telerehabilitation.	Clinic/Home	1-minute walk test; 10-meter walk test; 30-s chair rise.	A VC group showed greater improvement for the 1 MWT.
	Hielkema et al., 2020	RCT	n = 43, 9–21 m	COPCA	Physiotherapists and caregivers' sessions	Home	Video-recorded physiotherapy sessions	Neuromotor, cognitive, and behavioural outcome of the two intervention groups at the various measurement moments was similar.

VC, video conferencing; RCT, randomized-controlled; PRCT, pilot randomized-control trial; nRCT, non-randomized-clinical trial; FA, functional analysis; ABA, applied behaviour analysis; ADOS-2, autism diagnostic observation schedule; LFT, lost-to-follow-up; ITT, intent-to-treat; PLS, Preschool Language Scale; IMP, Infant Motor Profile; AIMS, Alberta Infant Motor Scale; COMP, Canadian Occupational Performance Measure; GAS, Goal Attainment Scaling.

studies, the results do not show a significant difference between the parents coached via telemedicine and independent consulting in clinics (19, 20). Little and colleagues (21) have also found that telemedicine-based coaching helped families who had children with ASD to increase child participation in daily care situations (playing, painting, doing a puzzle etc.) and goals which parents had set at the beginning of the research. In all these studies, authors suggest that telehealth service can be effective for families who live in the areas far away from specific help they need (19–21).

There were five studies focused more on behaviour problems where the main aim of the research was to coach parents how to deal with those situations. Sourander and colleagues (22) have presented a large study with 464 children with behaviour problems. The focus was on the Strongest Families Smart Website (SFSW) program, which included 11 weekly internet-assisted sessions of parent training that also included weekly telephone coaching. The program consisted of developing skills to strengthen parent and child relationships, encourage positive behaviour, reduce negative situations, and develop skills in daily care situations. Children did not participate in the coaching program, only parents, and after coaching they had to demonstrate what they learned during coaching time. The main outcome was the development of the Child Behaviour Checklist, Parenting Scale, 21-item Depression, Anxiety and Stress Scale and parent satisfaction measures. The results showed that an internet-based telemedicine program could provide early intervention for parent coaching to reduce negative child behaviour. Additionally, parents felt more confident and satisfied with their capacity to deal with their child behaviour problems and showed decreased parenting stress levels. However, Comer and colleagues (23) have found that internet-based VC adaptation in early intervention for children with behaviour problems may offer better results not only right away after intervention, but also in follow-up cases, several months after intervention. Families reported high satisfaction levels following the intervention and felt more confident in critical situations with their child, as well seeing decreased behaviour problems with their children. Thus, real-time access of expert services can offer qualified early care for families who live far away from healthcare centres. The management of mild behaviour problems and behaviour problems dependent on sleep quality for children may decrease if telephone call consultations are used for parents' coaching during a few weeks of intervention (24, 25). Singer and colleagues (26) have examined complex motor stereotypies using coaching and telephone access to a behavioural psychologist. The combination of home-based, parent-administered behavioural therapy and the telephone support with a therapist was effective in reducing complex motor stereotypies in youngsters (26).

Four studies were found that evaluated the possibilities in the delivery of EI to children with hearing loss. Parents who participated in coaching interventions improved their knowledge of paediatric hearing and language-promoting activities and were more engaged in hearing and language enrichment activities with their child. The data from a study by Constantinescu (27) revealed that auditory verbal therapy (AVT) delivered via telehealth using videoconferencing had the same effect on language development as conventional AVT in usual care. Havenga and colleagues (28) provided preliminary evidence that videoconferencing intervention is effective for communication intervention and may be a good solution for those families that are not able to easily access services. Behl and colleagues (29) revealed that tele practice for infants and toddlers who are deaf or have hearing problems may be an effective way to help and support families, but the authors have declared that this does not mean that tele practice should take active place by itself. The authors suggest that tele practice use could be a valuable tool not only for local but also for global help and it can be a cost effective method for delivering high quality help (30).

There were four studies which evaluated delivery of EI using telemedicine methods to children with speech and language impairments. One of the studies investigated the effect of a three-month text messaging therapist-assisted program which identified support for promoting language development, involving an inexpensive platform to connect families with qualified help (31). The authors suggest that videoconferencing sessions may be a cost-effective method without reducing the quality of support (15, 32).

There were two studies oriented on complex developmental problems. A three-minute video parent decision aid and short service message were provided as an intervention. Although there was some potential effectiveness shown in parents' knowledge and attitude, it was not significant (33). The other study findings suggest that a nine-week coaching intervention delivered via telehealth by trained, community-based EI providers may be effective in promoting child goals and parent reported satisfaction with child gains. The results revealed significant improvements in parent satisfaction, child performance, and goal attainment (all $P < 0.01$) (34). There also were two studies oriented on development disabilities by using COPCA. The first study observed children with special needs and the second study was about children with high risk of CP,

both of which demonstrated good results and high caregivers' satisfaction (35, 36).

There were only two studies focusing on preterm infants and their development using an innovative telerehabilitative tool that can be undertaken in home environment (37). In the CareToy study, there were 64 infants. One group was CareToy intervention and the other group was usual care intervention in the hospital setting. CareToy sessions were used daily for 30–45 minutes for four weeks. Infants performed activities using the CareToy tool, and all sessions were held using a real-time web camera. A specialist in a designated health centre analysed sessions and gave feedback to parents during telephone calls, videocalls or when they came to the centre. The results showed that CareToy system was a promising intervention for home-based, individualised EI in preterm infants without severe conditions. However, this study analysed the short-term effects, and large studies are needed to validate long-term use for children with severe conditions. Another study used COPCA and analysed differences between standard infant physiotherapy and the family-centred programme and COPCA. COPCA participants improved significantly more between baseline and 18 months in the infant motor profile (IMP) variation and performance domains than standard care participants (38).

One study examined unilateral spastic cerebral palsy (39). After training caregivers provided exercises via weekly telerehabilitation. Lower-extremity intensive functional training showed progress in a one-minute walking test, ABILOCO-kids (which is used like a measure of locomotion ability with lower limb impairments), social interaction and attention between caregiver and child (39). Another study compared the outcome of infants at a very high risk of CP after receiving the family-centred program COPing and CAring for infants with special needs (COPCA) or typical infant physiotherapy. There was no significant difference between two intervention groups at neuromotor, cognitive, and behavioural outcomes (40).

Discussion

There were 38 studies reviewed showing that telehealth has a potential for ASD, speech, and language impairments identification. Some studies also show that telehealth can be a promising model to deliver behaviour, communication, speech and hearing targeted interventions. Most studies show that telehealth service delivery is cheap, feasible and effective to implement screening and especially parent coaching to deliver EI interventions. Several studies show significant improvement in parent satisfaction, child performance, and goal attainment. The number of children with NDD is growing, so demand in EI is growing rapidly. Over the past century, new research in neurosciences has contributed to new approaches to EI for children with NDD. Early diagnosis, goal-directed, intensive, and active interventions, individual, complex and family-centred health care have become mandatory components of EI. Consequently, there is a significant gap between the intensive service requirements for children with NDD and the available resources to provide these services (REF). Although telehealth might address this gap, the results of our review show that the use of telehealth in EI is not well investigated. The studies that were conducted focused mostly on autism, speech and language delays and hearing loss. The use of telehealth in service delivery for parents and children with other kinds of NDD, such as cerebral palsy, attention deficit hyperactivity disorder, and global development delay were addressed only in two studies with preterm infants. There is a possibility that in future EI professionals will have cheap, feasible, reliable, and valid tools for screening and diagnosis of children with ASD and DLD. The main concern is that not one study explored tools for identifying motor delays and/or CP. Future research is needed to address this gap.

The research exploring the use of telehealth to deliver interventions is limited as well. Like studies investigating telehealth-based screening tools, interventional studies focused only on ASD and DLD. Interventions aimed to help the families and children with other kind of disabilities are not investigated. Nevertheless, there is evidence that telehealth-based interventions could achieve the same results as conventional practices.

Finally, telehealth as a service delivery method is well supported by families, practitioners, and community. The studies revealed that parents feel as comfortable as face-to-face when discussing problems with the therapist online. This is a very important factor which should encourage researchers to create new tools and therapies that could be delivered using remote technologies. The evidence suggests that health practitioners working with children with disability should introduce telehealth in their everyday practice. This is very relevant in these days where telemedicine becomes more and more useful, especially in the pandemic times. Because of social distancing, social activities, clinics, and physiotherapy were closed. This kind of lifestyle change affected children and caregivers.

There was one study that described children with Special Educational Needs and Disabilities (SENDs). This pandemic may affect children with SENDs and their families, and this could have negative implications for their mental health. The study involved 241 parents or carers of school-aged children with SENDs in the United Kingdom.

An oversized proportion of families report that COVID-19 has affected their mental state, often resulting in a rise in anxiety and fear. Smaller numbers also reported increases in distress, low mood, and stress (41). There is evidence within the literature that children with SENDs and their families are likely to be at a greater risk of experiencing a poor psychological state, and to be under substantially greater pressure than less vulnerable families during COVID-19 (41).

Besides, social distancing and its effects are extremely novel and difficult to know for youngsters, especially those experiencing developmental and intellectual delays. This has an impact on their well-being and may result in a higher risk of clinically significant mental health issues. Conducting international research on mental health consequences on children with physical and mental disability is of utmost importance to seek long-term solutions to combat this issue (42). There was one study demonstrating that the families' response to the proposal of video-sessions was positive with 93% of families accepting it, preparing appropriate devices and conditions to participate at home (43). The main limitations of this review are that the search was performed only in three databases, so some eligible articles could be missed.

Conclusions

Results suggest that telehealth is a promising service delivery approach in early interventions for children with autism spectrum disorders, speech, language, and hearing impairments that warrants additional research. The feasibility of telehealth in early interventions for children with other types of neurodevelopmental disorders (e.g., cerebral palsy) also should be explored. Future large-scope research studies are needed to prove the effectiveness of telehealth cost and the quality level of early intervention sessions.

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Conflict of Interest

No conflict of interest has been declared by the authors.

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